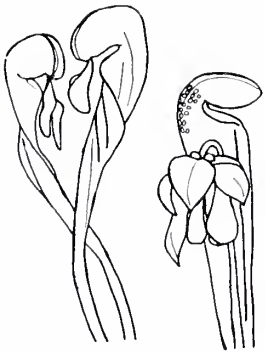
CARNIVOROUS PLANT NEWSLETTER

VOLUME 7, Number 2 JUNE, 1978



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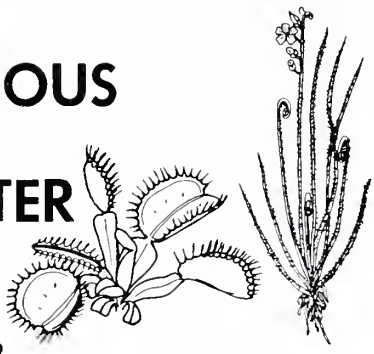

Volume 7, Number 2
June, 1978

Cover

Pinguicula pumila growing in its native habitat in Walton County, Florida on Mar. 10, 1972. This is one of the smallest in the genus measuring only about 1 inch/2.5 cm. in diameter.

Photo by D. Schnell

Editor's Corner

We sincerely hope that our readers enjoyed the first issue of CPN under the new format. The error in the naming of *Nepenthes* on the back cover points out the confusion that surrounds the names of many *Nepenthes,* especially hybrids. This is covered in more detail in the NV section by Rich Sivertson. Of course we realize there is always room for improvement and we will certainly do our best.

We would like our readers to submit good quality glossy black and white photos for use inside CPN. Photos can be returned after use if requested, but we would like to begin to accumulate a picture file of CP.

Copy deadline for the September issue is August 1, 1978.

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Seed Bank

Patrick Dwyer (St. Michael's Episcopal Church Gardens and Arboretum. 49 Killean Park. Albany, NY 12205) reports that the Seed Bank has been very popular. It is still growing and needs as many donations of seed as possible. Since publication of the last issue, the Seed Bank has contributed an additional $300.00 toward the publication of CPN. Many thanks to everyone who has supported this project!

For details of how to send or order seed, see CPN 7(1):3-5.

SEED BANK INVENTORY

April 27, 1978
Cost $.50 per pack
Please list substitutes

Byblis liniflora
Darlingtonia californica
Dionaea muscipula
Dionaea muscipula (x-ray 5000 rads)
D. aliciae (pale) 10*
D. aliciae (purple) 6
D. anglica
D. anglica possibly mixed with D. x obovata 4
D. binata 12
D. brevifolia 1
D. burkeana 2
D. burmannii
D. burmannii (Taiwan) 1
D. x californica 7
D. capensis
D. capensis (narrow)
D. capensis (reg. + narrow mixed)
D. capensis (narrow) & D. capillaris (long) mix 4
D. capillaris
D. capillaris (long leaf)
D. filiformis filiformis
D. intermedia
D. montana 10
D. natalensis 13
D. nitidula 6
D. planchonii
D. pulchella 5
D. pygmaea 3
D. ramellosa 2
D. rotundifolia
D. spathulata
D. spath. (Australian)
D. spath. (Kansai)
D. spath. (Kanto) 10
D. spath. (white flower)
D. stolonifera 2
D. villosa 1
D. whittakeri praefolia 2
Drosophyllum lusitanicum
Nepenthes khasiana
N. mirabilis
Polypompholyx multifida 1
Sarracenia alata
S. alata (purple throat) 4
S. alata (x-ray, 100 rads)
S. alata (x-ray, 550 rads) 7
S. flava
S. flava (copper) 6
S. flava (red veined) 1
S. leucophylla
S. minor 1
S. purpurea 2
S. purpurea purpurea
S. purpurea riplicola 9
S. rubra (savannah) 2
S. rubra alabamensis
S. rubra jonesii
S. alata x flava (copper) 12
S. alata x flava (heavy veined) 9
S. alata x leuco.
S. alata (purple) x leuco.
S. alata (purple) x leuco. (green vein) 7
S. alata x purpurea venosa 7
S. x catesbaei 14
S. x harperi
S. leuco. x minor? 1
S. leuco. (dark) x purpurea venosa 9
S. leuco. x rubra 12
S. leuco. x wrigleyana 1
S. leuco. (dark) x wrigleyana 12
S. minor (giant) x swaniana 2
S. x mitchelliana 5
S. oreophila x alata 2
S. oreo. (Little River) x flava (heavy vein) 1
S. oreo. x leuco. 1
S. oreo. x minor x leuco. (dark) 1
S. oreo. x minor x wrigleyana 2
S. rubra x alata 1
S. rubra (tall) x alata (purple) 3
S. rubra (gulf) x purp. venosa 3
S. rubra (savannah) x purp. venosa 1
S. swaniana x wrigleyana 2
Sarracenia mix
Sarracenia hybrid mix 2
Utricularia lateriflora 2
U. longifolia 15
U. subulata 6
CP. mix 2

* # of packets is listed if under 15

News and Views

ROBERT ALLAN (6117 Rockrose Dr., Newark, CA 94560) once lived in a small town of Mapleton, Oregon which is about 60 miles from Florence. He lived on a small ranch at the base of a mountain which had bog with a stand of *Darlingtonia.* At the time, he wasn't aware of what they were but several small restaurants along the road to Florence had pots of these plants which were attracting many flies. Apparently, the plants were used to attract and trap the flies indoors so that they wouldn't interfere with the customer's dining. Robert now lives in California and is presently growing quite a few CP plants for his pleasure.

ALAIN GODBOUT (38 Rue Labelle, Beauport Quebec, Prov. de Quebec; Canada G1E 5R3) writes that Charles Darwin who worked on *Drosera* physiology from about 1860 and corresponded with some colleagues on the subject. He wrote a letter to J. Hooker (July 29, 1860); two letters to Asa Gray (October 22, 1872 and June 3, 1874); one to Romanes (August 9, 1876); and a letter to Gaston de Saporta (December 24, 1877). In the letter to Gaston de Saporta he wrote ". . . I do not know whether you feel any interest about insectivorous plants. My son, Francis, fed with meat last summer a large number of plants of *Drosera rotundifolia* and left others unfed by excluding insects; and the difference between the two sets of plants in growth, and especially in the number and weight of the seeds was truly wonderful. He has sent a paper on this subject to the Linnean Society (1) a copy of which he will hereafter send to you. . ." (1) "Experiments on the nutrition of *Drosera rotundifolia*" 1880. Jour. Linn. Soc. Bot. 18: 17-32.

His works on the subject from 1860 eventually led to his book *Insectivorous Plants* which was published on July 2, 1875.

Ed. We wonder what was said in the other letters. Merci beaucoup, Mr. Godbout.

DAVID GRABER, (2241 Jefferson Ave., Berkeley, CA 94703) writes: I have a large clone of *Dionaea muscipula* which has been growing on my patio, outside in Berkeley, California for two years. It is now in a 15 cm pot which is packed solid with rosettes, an extremely vigorous plant. Last summer, four growth centers produced flowers. These were pollinated naturally by insects, and produced viable seeds, despite the fact that all plants were genetically identical, and there are no sources of pollen, to my knowledge, in the neighborhood. Apparently the necessity for outcrossing in *Dionaea* is not perfect.

Now, in February, despite the fact that nights have been averaging less than 8° C for two months, and have reached 5° C about 25% of the time, this clone now has four floral scapes, with buds that will be open in about a week. Although the production of new traps has slowed markedly, there is no evidence of dormancy. Last year, with a milder, sunnier winter, dormancy was achieved normally with this plant. The plant has never been fertilized. Explanations, anyone?

WALTER L. GREENWOOD (1838 Menold Court, Allison Park, PA 15101) wrote a very nice letter complimenting the new CPN format and color cover photos. He would like to start a carnivorous plant society locally in his area (western PA, Ohio, West Virginia) this year, eventually incorporating as a non-profit organization. In addition to educational,

research and manual publication functions, he would consider getting some of the Japanese works translated, and working into some sort of a conservation organization in order to save endangered locations in the areas specified. People outside the area would be welcome to join and participate as well. Mr. Greenwood is soliciting any ideas or advice from those interested in such an organization, whether they reside in the specified area or not. Please write him at the above address.

JEFF GROTHAUS (1265 Iliff Ave., Cincinnati, Ohio 45205) writes: For two years now, I cultivated CP and only last spring I started a record system which reports the origin, soil mix, temperatures and watering schedule for each plant I purchased. Furthermore, I jot down any observations and measurements on the growth of the plants and flowers which may be useful to know for future reference. In addition, I have taken color photos using a Polaroid SX-70 with a "close-up" lens. The pictures show sequential development of *Drosera montana* and *spathulata* as well as pitcher development on *Sarracenia minor*. A typical entry in my journal about a *Drosera binata* plant whose leaves were turning brown said: "The roots are black, firm and on 1/2/78 all growth above ground was dead. On 1/8/78, a small bud consisting of two uncurling shoots was discovered growing from the roots of the old plant. On 1/28/78, the plants average approximately 5 cm." This was fascinating to me because I wondered if this mechanism allows the plant to survive floods in their natural surroundings. Finally, I wonder if anyone has noticed whether cultivated Droseras grow better in groups than when planted individually. This would make an interesting experiment!

MICHAEL HUNT (11714 Lariat Lane, Oakton, VA 22124) writes: Last summer I discovered a most impressive site in eastern South Carolina. A huge stand of *Sarracenia* — looking over the savannah one could see the pitchers of *S. flava* as far as the eye could see growing in clumps. Along with the *S. flava* were *S. minor* and *S. rubra,* both rather abundant. *S. purpurea venosa* was also at this location but in lesser numbers. *D. intermedia* was the most common *Drosera;* however, *D. capillaris* was far from rare. Along the pools of water and near the small ditches where clumps of sphagnum could be found were *Pinguicula lutea,* with the larger plants near the shade of the pines. A few *Sarracenia* hybrids could be found at this site. This was a surprise. Of these a number of *S. purpurea venosa* x *S. flava* could be found, as well as a single plant of *S. flava* x *S. rubra.* In my opinion the most interesting, a small number of *S. rubra* x *S. minor* were growing scattered around a dried up pool. It was by far the largest stand of *Sarracenia* I had ever seen; the number of plants that grew at this site was a real surprise for me.

JOHN JAMES (28 Arran Ave., Hamilton, Brisbane, Queensland, Australia 4007) writes: I have a *Drosera binata multifida* plant from Stradbroke Island (see CPN *4,* 48 (1975)) which has produced a 46-pointed leaf. Most of the leaves of my plants have from 35 to 42 points!

JIM KOROLAS (36 Eastlea Crescent, Agincourt, Ontario MIT 3A6 Canada) relates a sad experience against which other CP people should guard: One day in October, I awoke to find my greenhouse in a total shambles — another victim of vandalism. The whole east side was slashed. At first I thought maybe it would have been the work of the wind and not some sick mind. However, upon further examination of the west side, I saw where the vandal(s) entered; a rec-

tangular hole had been cut in the plastic, and all the pots and trays were knocked to and fro with a rake from my back yard.

Perhaps I could have avoided the mishap. Placing the greenhouse beside the house instead of against the back fence, or in a well lit area, might have prevented the mishap. However, I now own a dog, and I am going to move the greenhouse up against the house. I will also add some sort of screening to protect the plastic from being so easily cut. I hope other CP enthusiasts will study the lesson I have learned and protect their CP from the same fate. What I find extremely hard to swallow is why my plants were destroyed and not just taken.

Jim continues with some hints on mailing into Canada: When mailing CP to Canadian collectors, the following must be observed in order to assure quick delivery (almost non-existent in Canada), and hassle-free delivery.

1. Canada is not part of the United States. I don't mean to put anyone down, but I have often received plants and letters from overseas countries, such as Australia, marked "J. Korolas . . . Canada, USA"!

2. Parcels sent to Canada via FIRST CLASS or AIRMAIL will not usually be opened if they have the blue customs label with the following written upon them: a) educational material (type of contents), b) No Commercial Value (value of merchandise).

3. Correct address is especially important in Canada, as the postal employees have now announced they will no longer correct incorrectly addressed mail, but instead will return it to sender.

Jim also sends along some comments on rare and endangered CP of Ontario summarized from a NATIONAL MUSEUM OF NATURAL SCIENCES publication entitled THE RARE VASCULAR PLANTS OF ONTARIO. *Utricularia geminiscapa* is listed as rare and apparently occurs only in the very eastern part of the province. *Drosera linearis* is apparently decreasing in the Sauble Beach area of the Bruce Peninsula, being present now in only a few specific locations of this very long beach.

ANDY LANIER (901 N. Greene Ave., Lake Worth, FL 33461) writes: I read your letter sent to Dave Horan about *Nepenthes* growing here in South Florida. This year I brought my *Nepenthes* into the house one night when the temperature dropped to 31°F. They are grown under a saran screen that provides 40% shade. I give no other protection. I now have *N. khasiana, kampotiana, mirabilis, x coccinea, x hookeriana,* and a thin narrow leaf plant tagged only as Peter Pauls'. Some plants are as tall as five feet at this time and since they are growing outside, they catch a sufficient amount of insects and therefore I do not fertilize. I am still growing them in a half & half mixture of osmunda fiber and sphagnum moss.

PAUL MC MILLAN (2155 Old Patagonia Road, Nogales, Arizona 85621). I am a new subscriber to the CPN which I think is superb and have gotten all back issues of it. I have grown various carnivorous plants for over 25 years now (I am currently 44) and their appeal has never diminished for me. I was born in Pennsylvania and a marvelous relict bog a short distance below Mt. Davis, the highest mountain in Pennsylvania contained *Sarracenia purpurea* and fired my initial interest. It has since, unfortunately, been inundated for a useless dam. Now that I live in Arizona (and not by choice) because my work is here. I naturally have to use distilled water on all my carnivores and generally provide a greenhouse environment. One carnivorous plant, contrary to Dr. Schnell's indications, does occur naturally in Arizona. *Utricularia vulgaris* occurs locally in pine country ponds based on acidic pink Coconino

sandstone in central Arizona at elevations of six or seven thousand feet.

PHIL MANN (130 Edward St., Bedford, 6052 W. Australia) sent in a photo of a huge *Cephalotus* plant he was growing in a pot. He says: That *Cephalotus* photo is a true one and the pitcher is 2½-3 inches high. It was a plant that I thought would grow in a pot so I put in some Osmocote, a slow release fertilizer, but I added nearly three times the recommended amount. I also gave it weekly doses of Fish emulsion fertilizer. I tried a few other plants with this same fertilizer but I killed each one so I guess I was lucky that time.

Do you remember those talked-about pictures in the May, 1964 National Geographic Magazine? Would you like to see more of those pictures of *Nepenthes* pitchers? Well, copies of the Kurata book titled: "Nepenthes of Mt. Kinabalu" have many color photos of the plants and pitchers of *Nepenthes*. This book is still available while limited quantities still exist. You can obtain a copy for $5.00 postpaid from JOE MAZRIMAS, 329 Helen Way, Livermore, CA 94550 or from W. I. P., Route 3, Box 338 S, Arroyo Grande, CA 93420.

After reading the Kurata book, many people have expressed strong desires to acquire and grow many of the *Nepenthes* species described in this book. Their desire is shared by many of us but it should be remembered that Mt. Kinabalu is a unique place with unique species of plants. This 13,000 foot granite mountain is a National Park and thus plants are protected (thank goodness!) from poachers and greedy people who would yank out the last plant for sale. Our hope is to obtain seed from these species which will enable us to have many plants to grow in the future.

HAL OWENS (12127 Broken Bough, Houston, TX 77024) is president of the Houston Insectivorous Plant Society and is seeking plant donations for his organization which is a little over two years old. Plants will be used to expand a large outdoor bog and an indoor space also. Plant donations are tax deductible and the society will provide any financial assistance for handling and mailing.

JAMES ROLLINS (P. O. Box 22, Ochlocknee, GA 31773) writes: There is a small bog near my home that is to become part of a four-lane highway. In this small bog can be found *Drosera filiformis, D. brevifolia, Sarracenia flava, S. minor, Pinguicula caerulea, Utricularia juncea.* Perhaps some plants and seed might be saved from this area before it is too late! Also in our area may be found many more species of the above genera, especially *Sarracenia leucophylla* and *Pinguicula lutea.*
Ed. Some CPN'ers in the area might want to contact him about saving these plants; removal under these circumstances is most certainly justified. (LCS)

While going through Santa Rosa County, Florida on 23 April 1978, DON SCHNELL noted that the well known Yellow River location had a for sale sign posted on a tree at the dirt track entrance going off the east side of the road just north of the bridge (the pond side). The company is Florida Homesteads Inc., and no city location or area code was given on the sign, but the phone numbers were 994-8425 and 623-0141. Since the closest cities are Pensacola and Ft. Walton Beach, the area codes for those cities may apply, this being 904 for both. Perhaps one of our Florida subscribers would like to check into this for us and let us know about acreage involved, exact portions of the location involved, cost, etc. There was no sign on the west side of the road, this being the side with the large open, disturbed wet area supporting tremendous growth of *Sarracenia rubra* and its hybrids with *S. leucophylla.*

PHILIP SHERIDAN (5729 So. 2nd St., Arlington, Va. 22204) informs us that Ireland is coming out with a set of stamps June 12 which will depict the native *Pinguicula grandiflora.* He has seen a picture of the stamp, and describes it as rather pretty. So if you're interested in CP stamps, here is your chance to get one.

RICH SIVERTSEN (309 96th St., Brooklyn, NY 11209) sends the following on the age-old problem with *Nepenthes*: The *Nepenthes* shown on the back cover of the last issue (Vol. 7, No. 1), photographed by Leo Song, is *not* *N.* x *dicksoniana* as stated, but what has been commonly known as *N.* x *dyeriana.* There has been much confusion concerning these two names. Of all the *Nepenthes* that I have observed in various collections, professional as well as amateur, all the plants labelled as *"N.* x *dicksoniana"* were in fact *N.* x *dyeriana.* I refer to *The Gardener's Chronicle.* Unfortunately, this is rather difficult to find. Even the book *Exotica* made at least two errors in *Nepenthes* nomenclature. Aside from their picture of *N.* x *dyeriana* labelled as *"N.* x *dicksoniana,"* they also made the common mistake of calling their *N.* x *mixta* *"N. superba."*

N. x *dyeriana* (= *N.* x *dicksoniana* x *N.* x *mixta*) was produced by Tivey in 1899, and was then called *N.* x *"Sir William T. Thiselton Dyer." N.* x *dicksoniana* is now believed to have gone extinct sometime during WWII. The former has a characteristic upward pointing lid, while the latter had a coarser peristome, and a horizontally pointed, slightly vaulted lid. The picture that Mr. Leo Song produced was an excellent example showing both the climbing and basal pitcher forms of *N.* x *dyeriana.*

While we are on the subject of common misnomers in *Nepenthes,* I would like to call your attention again to the plant *Exotica* called *"N.* x *superba." N.* x *superba* (= *N.* x *sedenii* x *N.* x *hookeriana*) was produced by Williams in 1880 and is pictured in Ill. Hort. 1881, p. 38. It resembles other hybrids of the same parents, such as *N.* x *williamsii.*

N. x *mixta* (= *N. northiana* x *N. maxima*) was produced by Tivey in 1892. This is the large and showy plant that seems to go by the names of *"N. superba"* or *"N. mixta superba."* One original form was once called *"N.* x *mixta* var. *superba Hort."* by C. Bonstedt in Parey's Blumengartenerei (1931). In 1894, M. T. Masters described a *N.* x *mixta* var. *sanguinea* in the *Gardners' Chronicle* as an excellent large and colorful form of the hybrid. I recommend L. H. Bailey's "Encyclopedia of Horticulture," although it is still incomplete as far as *Nepenthes* taxonomy is concerned.

WILLIAM A. SPIERS (35131 Brittany Park, Apt. 313, Mt. Clemens, MI 48043) has observed that *Drosera rotundifolia* plants that are native to basic soils grow more compactly and are less subject to rot than those transplanted from sphagnum. He wonders if anyone else has noticed this. Also, Bill is looking for criteria or methods of locating bogs in any given area, besides the use of soil survey reports.

OWEN TALLMAN (P. O. Box 72, Kelley Corners, N.Y. 12445). Since January of this year we have been publishing *Carnivorous Plants Digest,* a bimonthly which is designed to serve the popular horticultural market and to introduce novices in the field to information they can't find elsewhere. This commercial publication will discuss many elements of CP cultivation as a sound basis for horticultural pursuits. If your primary interest is growing CP you will probably benefit greatly from *CP Digest.* The *CP Digest* is evolving in form, size and content, and I would like to offer a sample issue for $1.50. It is the #1 issue, and

if you want the remaining five issues, those cost $8.50. The yearly subscription is $10.00.

Some CPN readers may be potential contributors to *CP Digest*. We pay modestly for contributions. If interested, send a stamped, self-addressed envelope for our contributor guidelines. Though *CP Digest* is copyrighted publication in one periodical does not necessarily mean a piece will be excluded from other publications. Comments and criticisms are also solicited. Please address inquiries to "Editor" and orders to "Subscription Dept.," CP Digest, PO Box 72, Kelley Corners, NY 12445.

ERNEST TANIGUCHI (45-1040D Wailele Rd.. Kaneohe, HI 96744) writes: I have some information for those CPNers who are interested in growing carnivorous fungi. They can write to Carolina Biological Supply Co., Burlington, NC 27215 and purchase a culture of *Arthrobotrys conoides* for $4.00 in test tubes or $5.00 in show plates. The culture media is cornmeal agar.

During winter vacation, I had a chance to go to Kauai but I didn't visit the Alakai swamp near Mt. Waialeale, the world's wettest spot. *Drosera anglica* grows in this swamp and next time I hope to visit this area and report on it later.

LARRI TUTEUR (2520 Idlewild Dr., Reno, NV 89509) writes: I was having trouble with something (apparently fly larvae or slugs) eating the leaves of my *Pinguicula*. I applied Pyrethrin (natural form), Allethrin (synthetic form) in much higher quantities than called for (not purposely) and was successful in stopping the damage. Because Pyrethrin is a contact poison (not systemic) it must be applied in successive 2-4 day intervals. I have also used Pyrethrin on *Dionaea* and several forms of *Drosera* and *Sarracenia* without harmful side effects.

I used the Whitmire No. 1200 Aerosol Generator available in the Ball catalog. I believe Pyrethrin is also available in concentrate form to be mixed before using.

JOHN WATKINS (98 Earls Court Rd., London, W.8; telephone 01-937 1080) is interested in starting a CP Society in Great Britain in 1979 and asks anyone interested to get in touch with him, whether they live in Britain or not. Please give him suggestions and ideas. and indicate whether you would be interested in membership and willing to help with organization.

EDWARD WEISS (Botany Dept., University of Georgia, Athens 30602) recently had the opportunity to observe Costa Rican Utricularias: During a recent Organization for Tropical Studies ecology course in Costa Rica, four species of *Utricularia* were seen. Two of these species, *U. endresii* and *U. jamesoniana*, were seen growing epiphytically in a cloud forest at 1600 meters elevation. Neither species was in flower at this time, February, and only vegetative structures were observed. The other two species, *U. foliosa* and *U. obtusa*, were found in flower in a seasonal marsh near the Gulf of Nicoya. Flowering had been ongoing for some time as many fruits were evident, as were fully flowered inflorescences. The production of propagules at this particular time may be related to the subsequent drying-out of these habitats. The fruits or seeds may remain dormant during this dry period and regenerate the population once the marsh refloods. This phenology appears to be unusual for a tropical *Utricularia*. During the next dry season I plan to return to Costa Rica to investigate this further.

The pollination biology of these two bladderworts was also observed. From these preliminary observations no visitors were found but fruits were still being

produced. It appears that selfing may be the mechanism at work. Further observations as well as crossings and exclusions are planned to determine which pollination mechanism is acting and how effective it is.

Any ideas or information on these tropical *Utricularia* and their life histories would be most welcome.

ROBERT ZIEMER (P.O. Box 4562, Arcata, CA 95521). For the past 3 months, I have been carefully cross-pollinating the flowers of *Heliamphora heterodoxa* and *H. nutans*. So far I cross-pollinated 10 flowers and I believe that seven of the ovaries are enlarging and the seed capsules appear to be developing normally. Last year, I self-pollinated *H. heterodoxa* and obtained over 100 seeds. I subsequently sowed 30 of the seeds and obtained 28 seedlings — a 93% germination!

I have observed that the stamens of my *H. heterodoxa* spontaneously dislodge and fall off the recepticle within a week after the petals open, whereas the stamens of *H. nutans* remain fixed to the receptacle for the duration of the flower and are difficult to dislodge or remove from the receptacle even months after the petals

(Continued on Page 62)

Review of Recent Literature

Adams, Richard M. 1978. Plant propagation by tissue culture. Am. Horticulturist 57(2):28-29.

A very good review of the general principles of propagative plant tissue culture with references to lead the interested reader into more depth not possible in an article of this length. This process assumes more importance as horticultural interest in CP increases and places a strain on natural populations and traditional propagation techniques.

DeBuhr, L. Wood anatomy of the *Sarraceniaceae:* ecological and evolutionary implications. Plant Syst. Evol. 128: 159-169 (1977).

A considerable number of primitive features characterize the wood of the family, *Sarraceniaceae.* Vessel elements in the genus *Heliamphora* have the greatest number of primitive features and *Darlingtonia* and *Sarracenia* appear to have modifications relating to temperate climates. All of the wood is similar to the wood of the order *Theales.*

Christensen, N. The role of carnivory in *Sarracenia flava* L. with regard to specific nutrient deficiencies. J. Elisha Mitchell Sci. Soc. 92(4):144-147 (1977).

Leaf tissue of *S. flava* was analyzed for total content of nitrogen, phosphorous, calcium, magnesium and potassium. Plants grown in nutrient deficient environments had lower contents of the above elements but insect-fed plants showed much higher concentration of nitrogen and phosphorous but not the other three elements.

Rost, K. & Schauer, R. Physical and chemical properties of the mucin secreted by *Drosera capensis.* Phytochemistry (OXF) 16(9):1365-1368 (1977).

There is only one polysaccharide macromolecule in the secretion of this CP with a molecular weight greater than 2 million. It exists as a 4% solution in water of an acidic polysaccharide containing xylose, mannose, galactose, glucuronic acid and ester sulfate in the ratio of 1:6:6:6:1. Although protein is absent the mucin contains calcium, magnesium, potassium and sodium cations. The mucin from *Drosera binata* has similar properties.

Short Notes

Capsella bursa-pastoris seeds. Are they "carnivorous"?

by John T. Barber
(Biology Department. Tulane University
New Orleans, La. 70118)

A recent article by Joe Mazrimas (1977) asked the question "Did you ever hear of carnivorous seeds?" The answer was probably an emphatic "No"! While the idea may have some intrinsic appeal, it is almost paradoxical in that one is so accustomed to thinking of carnivory in terms of adult plants and mechanisms which usually involve something more obvious and active than a seed, which just sits there. Nevertheless, it is the purpose of this article to suggest that certain plant seeds, particularly those of Shepherd's Purse (*Capsella bursa-pastoris*), have all of the necessary capabilities for carnivory.

Initially our work had been aimed at determining the potential of mucilaginous seeds (i.e. those which release a gummy covering or pellicle upon immersion in water — see Hyde, 1970 for a description of the anatomy and mechanism of mucilage release) for the biological control of mosquito larvae. The original observation of Reeves and Garcia (1969) that larvae became attached to such seeds and subsequently died was confirmed by Barber *et al.* (1974). The phenomenon is impressive when one can observe up to 20 larvae attached to a single seed which is little larger than a pinhead. The accompanying photo shows that larvae can become attached to the extent that the seed itself becomes completely obscured. Observations such as these were sufficiently dramatic as to prompt further investigation. It rapidly became evident that the interaction between seeds and larvae was more complex than at first appeared.

First, a survey of various seeds which have mucilaginous pellicles (principally members of the Cruciferae-Mustard family)revealed that they were not equally capable of entrapping larvae. Chemical analyses of the mucilages from different species of seeds indicated that a cellulose moiety was necessary for the mucilage to be "sticky", insofar as mosquito larvae was concerned. Those seeds whose mucilage lacked this cellulose fraction were unable to entrap larvae (Barber *et al.*, 1974).

Second, it has been demonstrated unequivocably that certain species of mucilaginous seeds upon immersion in water, release an attractant which promotes positive chemotaxis in mosquito larvae (Barber and Page, 1975). This chemoattraction was immediate and strongest in seeds which possessed a "sticky" pellicle. Seeds with a "non-sticky" pellicle evoked positive chemotaxis only after relatively long periods of immersion in water. Non-mucilaginous seeds generally showed no evidence of chemoattraction or only after prolonged soaking (Page and Barber, 1975).

The deadlines for the forthcoming issues of CPN are February 1, May 1, August 1 and October 1. Anyone having timely notices for show announcements or any other type message relating to CP which has reference to a future date should keep the above deadline dates in mind.

Larvae of the mosquito *Culex pipiens quinquefasciatus* attached to a seed of *Capsella bursa-pastoris*. Each larva is attached by its oral brushes to the mucilaginous pellicle surrounding the seed which is obscured by the heads of the larvae. Photograph by Dr. L. Y. Yatsu, Southern Regional Research Lab.. U. S. D. A.. New Orleans. La.

Third, it became apparent that larvae which had become entrapped by the mucilaginous seeds died at a much faster rate than they "had any right to". While a minute seed attached to the oral brushes of a larva may inhibit feeding, it does not appear to cause stress in terms of exhaustion, 0_2 deprivation, etc. The inference then was that a toxin was being released by the seeds; this was duly demonstrated by preventing attachment of larvae to seeds while maintaining aqueous contact between the two. Under these circumstances, the larvae died significantly faster than did larvae in the complete absence of seeds (Page and Barber, 1974).

At this point, some "strategy" on the part of the seeds seemed to be emerging. The seeds had a means of attracting, entrapping and killing prey but unless they had some use for the prey then there appeared to be little reason for the preliminaries. Therefore proteolytic activity was looked for using the method of Nelson *et al.* (1961). It was found that protease(s) were indeed liberated upon imbibition of *C. bursa-pastoris* seeds and that the proteolytic activity was confined to the mucilage (i.e. the site of prey attachment). Further, it was shown that germinating seeds were able to take up and incorporate labelled amino acids, indicating, presumably, that had these seeds been provided with a protein source (prey) they would, using their own protease(s), have been able to hydrolyze these proteins, making amino acids available for uptake and growth.

Thus, seeds of *C. bursa-pastoris* appear to have all of the necessary prerequisites for carnivory, at least as far as mosquito larvae are concerned (Barber and Page, 1976). They are able to attract, entrap, kill and digest prey. Further, they are able to take up the products of the digestion and utilize them to nourish the growing seedling. However, since *C. bursa-pastoris* seeds would seldom, if ever, encounter a mosquito larva under natural circumstances, then these phenomena can have little biological significance unless they are also effective against more "normal" prey i.e. organisms that the seeds could be expected to encounter under natural conditions. This possibility is currently being tested using such organisms as motile soil bacteria, nematodes and protozoans. While the results to date are still incomplete it is becoming clear that *C. bursa-pastoris* seeds are able to at least attract and kill certain of these organisms; entrapment appears to be less likely. However, if the seeds can attract and kill prey then actual entrapment would be somewhat superfluous anyway.

With regard to soil nematodes, samples of seeds were buried and at various time intervals thereafter (up to 7 days) they were recovered (as many as could be found) and examined under the micro-

scope for associated nematodes. The numbers of nematodes associated with the seed samples were compared with the number of nematodes associated with an identical number of similarly-sized soil and organic matter samples. The results showed a very clear preference of the nematodes for the seeds with ratios of up to 15:1 (numbers of nematodes per seed sample/numbers of nematodes per soil sample) being common. These results have been substantiated by lab experiments under more closely controlled conditions. The apparatus used was a modified, scaled-down, version of that used to demonstrate the attraction of *C. bursa-pastoris* seeds for mosquito larvae (Page and Barber, 1975). The distributions of nematodes (pure cultures of *Rhabditis* sp. and mixed natural populations obtained from soil) in a small (20 x 4 x 3 mm deep) plexiglass trough were determined at hourly intervals, up to 24 hours in the presence and absence of *C. bursa-pastoris* seeds. When no seeds were present in the trough the nematodes distributed themselves randomly throughout. In the presence of seeds, the nematodes accumulated in statistically significant numbers in the area of the trough which contained the seeds.

The effect of the seeds upon nematode survival was determined by placing identical populations of nematodes in depression slides. Seeds (2) were added to certain depressions and not to others. The populations were monitored over a period of eight days at which time only 25% of the nematodes in the presence of seeds remained alive as compared with 93% of those in the absence of seeds.

Similar results have been obtained using cultures of the protozoan *Colpidium striatum.* An H-shaped tubular apparatus was devised in which samples of the protozoan culture could be introduced into the center of the horizontal cross arm. The protozoans were then free to swim in either direction which they did in equal numbers to each vertical arm. However, when *C. bursa-pastoris* seeds were introduced into one of the vertical arms, say the right, then more than three times as many protozoans swam to the right than swam to the left. These methods have also been used to demonstrate the positive chemotaxis of the motile soil bacterium *Escherichia coli* to seeds of *C. bursa-pastoris.*

Evidence for the enhanced mortality of protozoans and bacteria in the presence of *C. bursa-pastoris* seeds is still preliminary but indicates that a toxin for these organisms is released by the seeds, upon imbibition.

The evidence therefore is strong that *C. bursa-pastoris* seeds are able to attract nematodes, protozoans and bacteria. It is also strong that they are able to cause increased mortality in nematodes; this also appears to be true for protozoans and bacteria, but the evidence is less complete here. Therefore, it appears that the sequence of events that has been well demonstrated using mosquito larvae is also possible for organisms that form a natural part of the seed's environment. It can be assumed that, having attracted and killed the prey, whether that is a mosquito larva, a nematode, a protozoan, or whatever, the seed's protease(s) is just as effective in digesting the prey's protein as it was in digesting the protein provided in the Nelson *et al.* (1961) assay. Similarly, one can assume that the amino acids so liberated can be taken up, incorporated and utilized for growth just as well as were the labelled free amino acids which came from a bottle.

The question now arises, does this all add up to carnivory? Certainly the potential seems to be there and one can fairly easily envisage circumstances under which germinating *C. bursa-pastoris* seeds would be able to supplement their nutritient with organic nitrogen derived from attracted, entrapped, killed and digested

prey. But why would they need to do so when a seed is usually thought of as being a self-sufficient entity? Many seeds having mucilaginous pellicles are found in nutritionally poor environments (Young and Evans, 1973) though *C. bursa-pastoris* itself is a relatively ubiquitous weed. In addition, the small size of the seeds (approximately 2 million/ lb. in the case of *C. bursa-pastoris*) makes them incapable of storing large amounts of endogenous food. Therefore, any plants that have acquired the ability to attract exogenous nutrients, as early as in the seed stage, would have a decided selective or competitive advantage. However, is all of this sufficient justification to apply the term carnivory? I wonder if proving carnivory is not a little like proving a crime, i.e. one must show motive, method and opportunity (eyewitnesses are helpful but not essential). Much of this has been demonstrated (or may be logically assumed) for *C. bursa-pastoris* seeds. Nevertheless, I am still somewhat reluctant to use the term carnivory and when it has been necessary I have tried to cover myself by using quotes — as in this article's title. I am encouraged to note, however, that even those who have worked with carnivorous plants longer and are more familiar with them than I, can question whether a particular plant is or is not truly carnivorous, e.g. Rose (1977) discusses "Is *Byblis* carnivorous?", similarly the article by Olivet and Mirimanoff (1940) is entitled *"Pinguicula vulgaris* L., est elle une plant carnivore?" For this reason I was pleased to see the article "Are carnivorous plants carnivorous?" by Williams (1975). *C. bursa-pastoris* seeds have been shown to fulfill all but one of the criteria for carnivory listed by Williams (1975); that one is that fed plants "prosper more than unfed control plants". This is a difficult determination to make since it does not involve life or death but rather the qualitative judgment of whether a fed plant is healthier in some respect than is an unfed plant. *C. bursa-pastoris* seeds do not appear to *need* prey in order to germinate and for the seedlings and subsequent plants to be quite healthy. However, neither do such accepted carnivorous plants as *Pinguicula* and *Drosera* (Harder and Zemlin, 1967; Harder, 1964). The concluding paragraphs of Williams (1975) indicate that a certain amount of semantics is involved in "carnivory". Given this and the various properties that *C. bursa-pastoris* seeds have been shown to possess, I leave it to the readers of CPN to judge whether or not they (the seeds, not the readers) are "carnivorous".

References

Barber, J. T. and Page, C. R., III (1975). Proc. N. J. Mosq. Cont. Assoc. 273-274.

Barber, J. T. and Page, C. R., III (1976). What's New in Plant Physiol. *8* (6), 1-5.

Barber, J. T., Page, C. R., III and Felsot, A. S. (1974). Mosq. News, *34*, 394-398.

Harder, R. (1964). Planta, *63*, 316-325.

Harder, R. and Zemlin, I. (1967). Planta, *73*, 181-193.

Hyde, B. B. (1970). Amer. J. Bot. *52*, 1197-1206.

Mazrimas, J. (1977). C. P. N. *6*, (1), 3.

Nelson, W. L., Ciaccio, E. I. and Hess, G. P. (1961). Anal. Biochem. *2*, 39-44.

Olivet, R. and Mirimanoff, A. (1964). Bull. Soc. Bot. Geneve, *30*, 230-235.

Page, C. R., III and Barber, J. T. (1974). Proc. Calif. Mosq. Cont. Assoc. *42*, 70.

Page, C. R., III and Barber, J. T. (1975). Mosq. News, *35*, 47-54.

Reeves, E. L. and Garcia, C. (1969). Mosq. News, *29*, 601-607.

Rose, S. (1977). C. P. N. *6*, (2), 28.

Williams, S. E. (1975). C. P. N. *4* (4), 64-65.

Young, J. A. and Evans, R. A. (1973). Weed Sci. *21*, 52-54.

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Standardized Photography of Pinguicula Blossoms

By Jurg F. Steiger (AUM, Inselspital 14, CH-1310 Berne, Switzerland)

In many plants, exsiccata* have the disadvantage of a considerable information loss. In such cases color photography may offer a valuable additional source of scientific information.

I. *Criteria for photographic scientific documents*

To be qualified as *scientific documents,* photographs of biological objects should meet specific criteria, which are exemplified here particularly for plant photographs:

1) If the purpose is to depict a "typical" phenomenon within any species or plant population, it doesn't make any sense to photograph just the first specimen catching the eye. Before shooting any pictures, the range of variability within the investigated population must be identified. This will allow one to determine which phenomena are typical and less typical and to select and label the objects of photography accordingly.

2) Pictures in which the size of the object of interest is important but not clearly obvious should show the object together with a scale, preferably in metric measure.

3) Each photograph should have an identification number and the relevant data of each picture must be registered in any sort of a record system (card index, computer file etc.). In particular, it must be registered whether the photographed phenomenon displays predominantly typical or aberrant findings.

4) In a series of comparative pictures of similar objects, as many parameters as possible should be constant (general display, film format, film brand, background color and structure, illumination, focal distance, filters and other accessories used, developing laboratory etc.).

5) Master negatives or master slides must be archived in a dark, dry place protected from extremely high or low temperatures in order to prevent any alterations.

* dried herbarium specimens

II. *The Record System*

It is better to *use consequently* a *simple* record system than to use inconsequently a perfect but time consuming one, or to dream from a never used but constantly improved superperfect system.

I began to use a simple file system in 1957 which I find still suitable today with several thousand photographs and slides. Each negative or slide has a chronological number, beginning each year at zero. The first two digits are the year, the next digits indicate the slide number. "77.26" means 1977, slide No. 26. The file card of this slide has the same number. The cards have a size of 14,8 x 10,5 cm (European A6-format). Fig. (1) shows a translated file card of the slide with *Pinguicula grandiflora* blossoms depicted in this issue (the original text is in German):

The *file cards* are archived in cardboard boxes, *chronologically for each year.* The *photographs and slides* are stored in *separate boxes* and pooled for each *species.* Within one species the picture material is subdivided in further categories (habitat, habitus, blossoms, seed capsules, seeds, leaves, hibernacula etc.). This allows a quick and differentiated retrieval according to production year, species, intraspecies and interspecies criteria.

III. *Standardized Photography*

A few years ago I began systematically to photograph *Pinguicula* blossoms, seed capsules, winter buds, etc., as these are particularly predisposed to unfavorable altering by the pressing and drying process in conventional herbarium specimens. In order to get comparable pictures, blos-

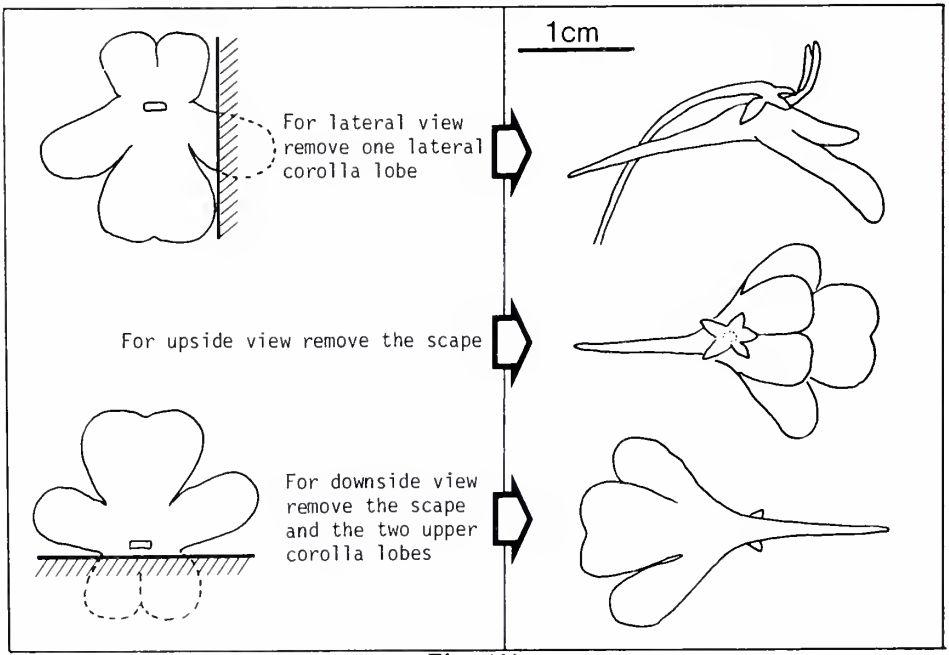


Fig. (1)

S = slide, P = paper picture, M = movie, BW = black and white, CO = color, DIN/ASA = film speed, SS = shutter speed (exposure), LO = lens opening (diaphragm).

som photography was standardized and after several trials with different blossom positions and background colors, the picture arrangement depicted in this paper was found to be most suitable.

In a trial series the slides of all species were photographed in the same absolute scale. The scale was determined by the largest blossoms (*Pinguicula moranensis*) with a flower length of more than 50 mm. However, for small species (*P. crenatiloba, P. villosa*) with blossoms of 5-7 mm, this results in ridiculous pictures with a tiny area of information surrounded by a giant uninformative background space. Therefore, it was decided to shoot the pictures in variable scales, allowing each set of three blossoms to fill out all the picture space. In another trial a fourth blossom was added, showing the blossoms in front view (a hole was cut into the background felt and the spur of the blossom was stuck into it). However, this was abandoned by reasons of circumstantiality and sometimes unsatisfactory depth of field.

For "typical" pictures of a species or population, three specimens are selected with "average" characteristics in size, shape and color. Additional comparative slides are made in cases where a conspicuous variability per se within a specific habitat is typical as shown in the examples of *P. longifolia ssp. reichenbachiana* and *P. moranensis* (color variations). Further slides are made to demonstrate other intra-specific differences (see examples of *P. macroceras* and *P. vulgaris,* each one growing on two different continents), differences between species or subspecies (see slide with the 3 "types" of *P. grandiflora*) and extreme variations (exuberant giant blossoms, nanism, shape or color deviations, atavisms and other aberrant findings). Similar standardized slides are being made from seed capsules, seeds, hibernacula, etc.

Technical procedure: To be able to position *Pinguicula* blossoms in lateral view it is often necessary to remove one lateral corolla lobe. For the blossom in downside-up position it is unavoidable to

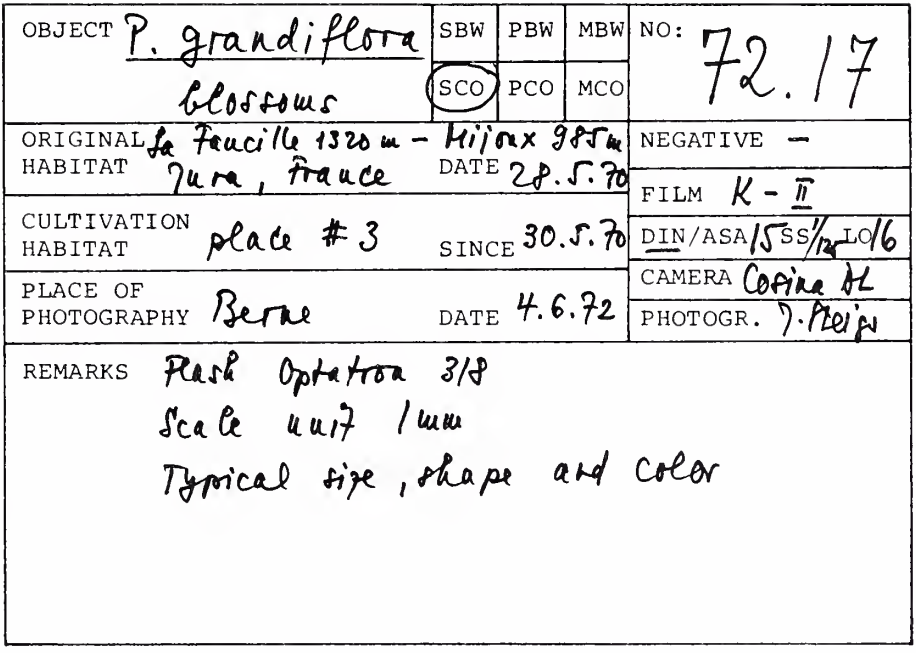


Fig. (2)

remove the scape and the upper corolla lobes (and sometimes the calyx). In the upside-up blossom the scape is just cut at its connection with the calyx (Fig. 2).

In case of difficulties in keeping the blossoms in place, I put some tiny lead balls into the corolla tube. Occasionally it is necessary to store already picked blossoms for some days in order to make a comparative slide with material to be gathered the next weekend. In this case, I put the blossoms into a tight plastic box coated on the inside with moist (not too wet), cotton wool or linsoft material. A fungicide is added to avoid mould. The box itself is put into the refrigerator at a place which does *not freeze*. In the coolness and fully water saturated atmosphere, the delicate blossoms are preservable and ready for photography up to two weeks.

Photographic equipment: Reflex viewfinder camera (Cosina DL) Lens 2,8/100 mm, extension tubes 11, 18 and 36 mm, three Hoya close-up lenses (1+, 2+, 3+), skylight 1B filter, tripod with a globuar head to allow shooting in vertical direction, electronic flash (Rollei 134B or similar model), metric scale, green self adhesive felt background on a cardboard piece, a pair of tweezers. Film: Predominantly Kodachrome slide films. However, good results were also obtained with other brands. To avoid long-cast shadows, the flash must be positioned very close to the camera lens axis. Therefore, a usual 55 mm lens is not suitable as there is generally not enough space to approximate the flash tube axis. The slide with *P. alpina* shows such a 55 mm lens picture with unpleasant shadows. Unless working with a fully self regulating feedback computer flash, it is necessary to determine the correct distance between flash and object for each object length by means of a test series.

All this equipment is packed up in a portable box and is ready for use anywhere, at home as well as in the field or in a tent. Much better and more sophisticated photographic hardware is on the

1. P. alpina

2. P. balcanica

3. P. corsica

4. P. grandiflora

5. P. grandifl. f. pallida

6. P. grandifl. ssp. rosea

7. P. grandifl./f. pallida/ ssp. rosea

8. P. leptoceras

9. P. longifolia ssp. caussensis

10. P. longifolia ssp. longifolia

11. P. longifolia ssp reichenbachiana

12. P. longifolia ssp. reichenbachiana

13. P. macroceras (Japan)

14. P. macroceras (USA)

15. P. macroceras ssp. nortensis

16. P. nevadensis

17. P. vallisneriifolia

18. P. vulgar/f. bicolor, f. albida

market today. However, flexible, rather simple amateur equipment as described above may well serve to shoot acceptable slides for many years.

IV. *Comments on the color plates*

The pictures show blossoms of the majority of the temperate growth type *Pinguicula* species (including one natural hybrid) and of four tropical growth type species (each group in alphabetical order). The length of the horizontal black stroke in the upper left corner of each picture is 1 cm.

With the exception of *P. corsica,* Japanese *P. macroceras, P. gypsicola* and *P. moranensis,* all other depicted specimens were collected by the author personally at the indicated localities. All photographs are by the author. The nomenclature follows the very well documented *Pinguicula* monograph by Casper (1966).

The abbreviations in the following indications mean:
LC = Locality of collection
LP = Locality of photography
K = Kodachrome

Temperate growth type species (alphabetically)

1. *P. alpina* — LC/LP Schwarzwasserbrücke 650 m, near Berne, Switzerland, 22.5.72 (K-II)

2. *P. balcanica* — LC between Hotel Shtastliveca and Cerni Vrach, Vitosha, 2290 m, near Sofia, Bulgaria, 17.9.76, LP Trogenmoos near Interlaken, Switzerland, 16.7.77 (K-25)

3. *P. corsica* — LC Lac de Melo, 1650 m, Vizzavona, Corsica, France, 24.8.69 (by Mrs. M. Conrad), LP Berne, Switzerland, 27.7.70 (K-II)

4. *P. grandiflora* — LC between Col de la Faucille, 1320 m and Mijoux, 985 m, Dept. Jura, France, 28.5.70, LP Berne, Switzerland, 4.6.72 (K-II)

5. *P. grandiflora f. pallida* — LC between Col de la Faucille, 1320 m and Mijoux, 985 m, Dept. Jura, France, 28.5.70, LP Berne, Switzerland, 10.6.70 (K-II)

6. *P. grandiflora ssp. rosea* — LC above Goncelin/Solliéres, 600 m, near Grenoble, Dept. Isére, France, 3.8.73, LP Berne, Switzerland, 23.5.74 (K-II)

7. *P. grandiflora/f. pallida/ssp. rosea* — LC *P. grandiflora* and *f. pallida* see Nr. 4 and 5, *P. ssp. rosea* see Nr. 6 but collected on 28.5.70, LP Berne, Switzerland, 24.6.70 (K-II)

8. *P. leptoceras* — LC below Grimselpass, ca. 1900 m, Switzerland, 16.8.68, LP Berne, Switzerland, 11.7.70 (K-II)

9. *P. longifolia ssp. caussensis* — LC below St. Enimie, ca. 420 m, Gorges du Tarn, Dept. Lozère, France, 4.9.68, LP Berne, Switzerland, 2.5.76 (Ektachrome-X)

10. *P. longifolia ssp. longifolia* — LC below Cirque de Gavarnie, ca. 1600 m, Dept. Hautes-Pyrénées, France, 22.8.69, LP Berne, Switzerland, 28.7.70 (K-II)

11. *P. longifolia ssp. reichenbachiana* — LC above Nizza, between Fontan and Tende, ca. 550 m, Dept. Alpes-Maritimes, France, 8.9.68, LP Berne, Switzerland, 2.5.76 (Ektachrome-X)

12. *P. longifolia ssp. reichenbachiana* — same data as No. 11, in contrast to the two other sub-species, this one has a conspicuous colour variability.

13. *P. macroceras* (Japan) — LC below Mount Nantaizan, ca. 2300 m, near Nikko, Tochigi Pref., Japan, 11.10.68 (by M. Kondo), LP Berne, Switzerland, 12.7.70 (K-II)

14. *P. macroceras* (USA) — LC upper Bagley Lake, Mt. Baker Lodge, ca. 1600 m, Whatcom County. Washington, USA, 29.8.71, LP North Bend near Seattle, USA, 30.8.71 (K-II)

15. *P. macroceras ssp. nortensis* — LC Sheep Pen Creek, ca. 1000 m, between Crescent City and Gasquet, Del Norte County, California, USA, 7.5.71, LP Los Angeles, USA, 10.5.71 (K-II)

16. *P. nevadensis* — LC Laguna de las Yeguas, 2850 m, Mt. Veleta, Sierra Nevada, Spain, 18.8.69, LP Silvaplana, Switzerland, 31.7.70 (K-II)

17. *P. vallisneriifolia* — LC Cueva de la Maddalena, ca. 1200 m, Iruna, Sierra de Cazorla, Spain, 20.8.69, LP Berne, Switzerland, 10.6.70 (K-II)

18. *P. vulgaris/f. bicolor/f. albida* — LC *P. vulgaris* and *f. albida* Grünenbergpass, 1500 m, near Interlaken, Switzerland, 26.6.76, *f. bicolor* see Nr. 21, 3.6.67, LP Trogenmoos, near Interlaken, Switzerland, 26.6.76 (Agfa CT-18)

19. *P. vulgaris* (Europe) — LC Col des Montets, 1445 m, Switzerland, 13.8.70, LP

Trogenmoos, near Interlaken, Switzerland, 16.8.70 (K-II)

20. *P. vulgaris* (USA) — LC Pictured rocks, ca. 200 m, Lake Superior, near Munising, Michigan, USA, 26.9.71, LP Berne, Switzerland, 21.5.72 (K-II)

21. *P. vulgaris f. bicolor* — LC Les Amburnex, near Col du Marchairuz, 1450 m, Jura, Switzerland, 3.6.67, LP Berne, Switzerland, 11.7.70 (K-II)

22. *P. hybr. leptoceras* x *vulgaris* (or vice versa) — LC Oberalp-Pass, ca. 2000 m, Switzerland, at common locality of both parent species, 30.7.70, LP Berne, Switzerland, 12.7.72 (K-II)

Tropical growth type species (alphabetically)

23. *P. gypsicola* — LC ?, cultivated at the Botanical Garden, University of Berne. Switzerland, LP Berne, 29.8.70 (K-II)

24. *P. hirtiflora* — LC Valle delle Ferriere. ca. 200 m, above Amalfi, near Naples, Italy, 29.6.76, LP Amalfi, Italy, 2.7.76 (Agfa CT-18)

25. *P. lusitanica* — LC Lake Goller, ca. 280 m, near Lisdoonvarna, Clare County, Ireland, 31.5.75, LP Trogenmoos, near Interlaken, Switzerland, 11.8.75 (K-64)

26. *P. moranensis* — LC ?, cultivated at the Botanical Garden, University of Berne, Switzerland, LP Berne, 29.8.70 (K-II)

27. *P. moranensis* — LC/LP see Nr. 26, three color variations

V. *Suggestions to CPN Readers*

Regarding the fact that this bulletin now offers publication of color pictures, the following suggestions are made:

1. Other CP growers with photographic interests adopt the described technique for pictures of *Pinguicula* blossoms and send their slides to the editorial board. As soon as there is a pool of some new slides, they are published in another issue of this bulletin. The final objective would be to have a multi-authored but standardized photographic color documentation of each of the 49 *Pinguicula* species.

2. CP growers specialized more in *Utricularia, Drosera, Sarracena, Nepenthes* etc. are encouraged to develop similar methods of standardized photography for these CP. Such activities should be reported to the editorial board to facilitate coordination.

3. The author will offer free of charge 5 different duplicates of the depicted color slides to each one of the first three persons who send him at least one color slide of *Pinguicula* blossoms photographed in the proposed manner (preferably from other species than those depicted in this paper).

VI. *References* (for nomenclature)

Casper S. J., On *Pinguicula macroceras* in North America, Rhodora, Vol. 64 (1962) pp. 275-292

Casper S. J., Monographie der Gattung *Pinguicula;* Biblioteca botanica, Vol. 127/128, Stuttgart (1966)

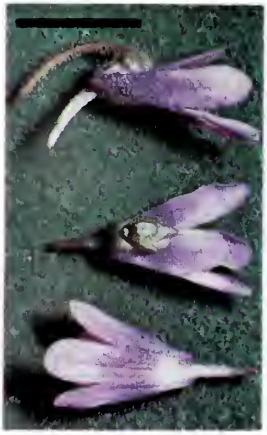
Steiger J. F., The *Pinguicula* Species of the Temperate Growth Type and their Cultivation, Carnivorous Plant Newsletter Vol. IV, NO. 1 (1975), pp. 8-18

VII. *Acknowledgements*

I thank the following persons and institutions for having provided me with plant material depicted in this paper: M. Kondo, Nagoya (for *P. macroceras,* 1968), Mrs. M. Conrad, Bastia (for *P. corsica,* 1969), University of Berne Botanical Garden (for *P. gypsicola* and *P. moranensis,* 1970).

NOTICE: We believe many readers would be interested in having 35 mm duplicate slides of the color illustrations in Jurg Steiger's paper on color photography of *Pinguicula* flowers printed in this issue. Jurg has kindly given us permission to duplicate the original slides, which are of excellent quality, and these will be held as sets for cost of duplication plus postage and packaging. We did not have time to get together the pricing workup on this before this issue went to press, but the September issue will contain details on how to obtain these slide sets.

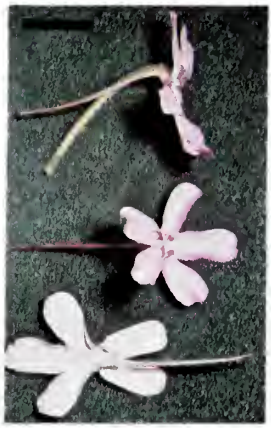
19. P. vulgaris (Europe)



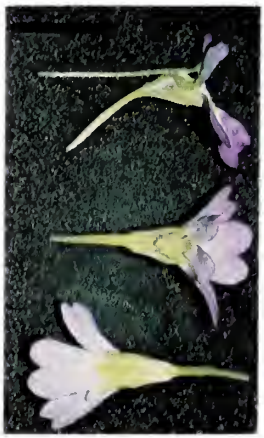
20. P. vulgaris (USA)

21. P. vulgaris f. bicolor

22. P. leptoceras x vulgaris



23. P. gypsicola



24. P. hirtiflora

25. P. lusitanica

26. P. moranensis

27. P. moranensis (color variation)

The Uptake of Digestion Products by *Drosera*

By Dr. Graeme Chandler

(Continued from last issue)

Bacteria are associated with all of the carnivorous plant genera, and it was reported that the degradative activity of the bacteria associated with *Darlingtonia* and *Heliamphora* provide the only means available for digesting insects. In other carnivorous genera, there are conflicting reports as to whether entrapped prey are digested by bacteroid enzymes or enzymes secreted by the plants.

Reports of proteolytic enzyme activity associated with *Drosera* are numerous; however, many authors give different pH optima for their particular enzyme. This indicates that possibly the enzymes are of bacterial origin and reflect different bacterial populations associated with *Drosera* at different times. Accordingly, we looked at the bacteria associated with the mucilagenous material on the glandular hairs of *Drosera binata* to see whether or not they produced extra-cellular proteases.

Mucilagenous material was streaked onto agar plates and left to grow for 48 hrs. The five most rapidly growing bacteria were isolated and then examined for proteolytic activity in two ways. One way involves letting bacteria grow in vials in a 10% gelatin solution containing essential salts for 48 hrs. and then placing the vials in the freezer. If the bacteria are producing extracellular proteases, then the gelatin solution will not freeze because of gelatin hydrolysis. The second method is more complicated and more reliable and it involves the bacterium *Salmonella typhimurium*. Certain strains of *S. typhimurium* produce what is termed colicin, which is a diffusible protein toxic to many bacteria as it prevents oxidative phosphorylation, inhibits protein synthesis and/or causes degradation of bacterial DNA. Bacteria which produce extracellular proteolytic enzymes are insensitive to colicin as the toxic factor is hydrolyzed by the proteolytic enzyme. Single colonies of the bacteria isolated from *Drosera* tentacles were plated on agar plates and at the same time *Salmonella* was also plated at varying distances. Growth was continued for 24 hrs. and then the agar flipped over to expose a new sterile surface. An overnight culture of *E. coli* (sensitive to colicin) was surface seeded and growth continued for 24 hours. The plates were then examined for the growth of *E. coli*. If the *E. coli* grows above a *Salmonella* colony, then the other plated bacteria is producing an extracellular protease. All bacteria isolated from *Drosera* tentacles have produced extracellular proteolytic enzymes.

Leaves of *D. binata, D. auriculata* and *D. whittakeri* were examined for proteolytic enzyme activities over broad pH spectrums using three assay methods. The three methods were the ninhydrin technique where the increase in alpha-amino nitrogen is recorded as a complex with the ninhydrin reagent; the second method used casein as a substrate and hence the increase in absorbance at E 280 can be recorded. The third method involved using ^{14}C-labelled protein and we could measure the ^{14}C-peptides or amino acids left in solution after precipitation with T.C.A.

All the plants examined had more than one pH maximum for optimum proteolytic enzyme activity; all species have had a low pH maximum proteolytic activity around pH 3.0 and generally a rather broad band anywhere from pH 4 to pH 8. If proteinaceous material is supplied to the leaves of carnivorous plants, then we tend to get an increase in proteolytic activities right across the board.

The next question was what happens in sterile culture? Seed of *D. binata* was

sterilized and placed into 500 ml agar flasks. When the plants were mature, then they were assayed for proteases and all that we found was one pH maximum indicating the presence of only one proteolytic enzyme in sterile tissue. Using the ^{14}C-labelling assay, the pH maximum was 3.0. This pH maximum is very similar to the proteolytic enzyme reported in both *Nepenthes* and more recently in non-sterile plants of *Drosera capensis*.

Since insects possess a chitinous exoskeleton, we would assume that carnivorous plants would possess a chitinase enzyme to hydrolyze the chitin to the monomeric units of N-acetyl-D- glucosamine. There has only been one report of chitinase activity in carnivorous plants and that was with a non-sterile *Nepenthes* fluid. Leaf extracts of *D. whittakeri* exhibit chitinase activity even though the level of enzyme must be very low. When we examined sterile tissue of *D. binata,* however, we could detect absolutely no chitinase activity at all. So sterile plants have their own proteinase activity but not their own chitinase.

If plants have their own proteinase but no chitinase, this may indicate that bacteria would be necessary if the exoskeleton is degraded. Reports with some carnivorous plants suggest that insect exoskeletons are found in the pitchers of *Nepenthes,* but no long term study has been initiated to see how long the exoskeletons remain. In the growth experiment recently concluded, we tried to determine whether or not spraying the leaves of *Drosera whittakeri* with a bactericide would influence the growth of plants supplied insects. There were four treatments:

1) Plants grown in low nutrient.

2) Plants grown in low nutrient plus bactericide.

3) Plants grown in low nutrient plus insects.

4) Plants grown in low nutrient plus bactericide and insects.

Plants were sprayed every two days with a mixture of penicillin, Streptomycin, Pimafucin and polymyxin, i.e. a bactericide and fungicide. The results were:

	Weight in mg.	*Probability (%)**
Treatment 1	15.9	A
Treatment 2	16.1	A
Treatment 3	18.9	B
Treatment 4	14.9	A

*Values followed by the same letters are not significantly different.

The results suggest that bacteria or rather micro-organisms, since fungi are also associated with leaves of *Drosera,* play a significant role in the nutrition of this plant possibly by providing enzymes necessary for more rapid or complete hydrolysis of insect metabolites.

Carnivorous plants must be able to utilize metabolites bounded by the exoskeleton of prey which are captured; relatively few reports, however, can be found concerning the absorption of nutrients from prey by these plants. Many authors have demonstrated the uptake of radioactive metabolites such as ^{32}Phosphorus and ^{35}Sulphur but not from prey bounded by exoskeleton. Since sulfur of insect origin was shown to be important in the growth experiment with *D. whittakeri,* insects of *Drosphila melanogaster* grown in $^{35}S(SO_4=)$ were supplied sterilized to the plant leaves for 48 hrs. and the labelling pattern of the insect metabolites were monitored. The labelling patterns were reproducible and the sulfur containing insect metabolites identified by extensive chromatography. Sterile insects were supplied to *D. binata* grown in sterile culture. In addition, $^{35}SO_4$ was supplied directly to the leaves of the plants for 48 hrs. Similar experiments were conducted with non-sterilized flies supplied to plants grown under field conditions. The tentacles of these plants are known to harbor a wide variety of micro-organisms.

The results show that the labelling pat-

tern of sterile plants supplied with ^{35}S-labelled insects was qualitatively similar to the labelling pattern to which $^{35}S(SO_4)$ had been administered directly to the tentacle. Also, the labelling pattern resembled in most experiments the same one obtained from the insects alone. Even similar patterns were obtained when non-sterile insects were supplied to plants grown under field conditions.

The similarity of the labelling patterns in all cases does not allow us to determine whether sulphur containing insect metabolites are degraded first to $^{35}S(SO_4)$ or whether the labelled compounds are taken up *per se*. We have attempted to answer this problem by supplying by supplying ^{3}H and ^{35}S-methionine, an amino acid, to the leaves of *D. binata* growing in axenic culture for a given time and then determining the labelling pattern of the plant metabolites. We would expect one of two things to happen:

1) If the methionine is degraded on the leaves, the sulfur atom is then taken up as $SO_4=$ and then we would expect to obtain a labelling pattern similar to that of only $SO_4=$ applied directly to the leaves.

2) On the other hand methionine could be taken up without being degraded and be subsequently metabolized into other compounds. In this case, the % of the ^{3}H-label present in methionine following application of ^{3}H-methionine to the leaves should be the same as the % of the total ^{35}S label following application of equilmolar ^{35}S-methionine.

Accordingly, we supplied both sterile and non-sterile *D. binata* with ^{35}S-sulphate, ^{35}S-methionine and ^{3}H-methionine and determined the plant labelling patterns at ½, 6, 18 and 48 hrs. after the application of the isotopes.

If we consider the plant metabolite patterns at the 6 hr, then we see virtually the same compounds present irrespective of whether ^{35}S or ^{3}H methionine was supplied to the plant. These patterns are substantially different from those obtained when $^{35}S(SO_4)$ was supplied suggesting that methionine is not degraded to SO_4. Further, the % of total ^{3}H and ^{35}S label still present in methionine after 6 hrs. in both sterile and non-sterile plants is similar. We conclude, therefore, that methionine is taken up *per se*.

In summary, we have shown an enhancement of growth of *D. whittakeri* by insects in both nitrogen and sulphur deficient regimes implying that there is uptake of nitrogen and sulfur containing metabolites from the insect to the plant. Application of insects to plants raised in phosphorus deficient regimes did not enhance growth; however, this may be due to the high levels of phosphorus contained in the tubers. Bacteria associated with the leaves of *D. whittakeri* produce both proteases and chitinases and also make significant contribution to the growth of plants grown under a low level of nitrogen. *D. binata* grown in axenic (sterile) culture only produces one protease with pH optimum of about 3.0 and does not exhibit any chitinolytic activity. There is uptake of ^{35}S-insect metabolites under both sterile and field conditions. The uptake by sterile plants demonstrates that mobilization of insect metabolites is independent of bacterial activity, but this process in the field is likely to be insignificant. The uptake of methionine and presumably other compounds occurs *per se*. It is not mediated through degradation to inorganic sulphate.

REFERENCES

Chandler, G. E. and Anderson, J. W. Studies on the Nutrition and Growth of *Drosera* Species with Reference to the Carnivorous Habit. New Phytologist. *76*, 129 (1976).

Chandler, G. E. and Anderson, J. W. Studies on the Origin of Some Hydrolytic Enzymes Associated with the

Leaves and Tentacles of *Drosera* Species and Their Role in Heterotrophic Nutrition. New Phytologist 77, 51 (1976).

Chandler, G. E. and Anderson, J. W. Uptake and Metabolism of Insect Metabolites by Leaves and Tentacles of *Drosera* Species. New Phytologist 77, 625 (1976).

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CP Field Trip July 1977

by

Randall Scott Bennett

(517 E. State St., Ithaca, N. Y. 14850)

In July of 1977, I drove from Orlando, Florida, to San Jose, California. I also drove up the coast of California from L. A. to Oregon, but the area of primary interest here is western Florida, Mississippi and Alabama, where I sought out the CP indiginous to the area.

A short drive from where I was staying outside Orlando, I spotted *Drosera capillaris* in a savannah-like field as well as alongside a small stream with dark muddy banks. The banks were exposed because the stream had obviously receded a few yards. The southern states as well as California were experiencing a drought. The ground of the field in which the plants grew was dried and cracking and all of the *D. capillaris* were small and some sickly looking. I was not hopeful for the prospects of observing other species of CP.

My first day's drive took me to Tallahassee, Florida, where I spent the night. A short drive and ensuing search revealed a water moccasin, some long-legged water birds and a wild clematis plant, but no CP. The following day I planned to reach Mobile, Alabama. Accordingly, I took Rt. 319 South from Tallahassee into Rt. 98 West, passing through towns with names like Crawfordville, Medart, and Sopchoppy. When I stopped along Rt. 98 near Carrabelle, Florida, I found *D. capillaris* growing in dry sandy places as well as wetter areas along ponds and small streams. Also seen was *D. intermedia*. The *D. intermedia* grew only in the wet areas further in from the roadside; the *D. capillaris*, however, extended almost to the road.

I was discouraged because many areas were dried up and I had not yet seen any *Pinguicula* or *Sarracenia*. Further west between Westbay and Destin, Florida, on Rt. 98, I found groupings of *Pinguicula* growing on the sloping intermediary area between the pine forest and the roadside ditch. The soil was very dry and sandy, and the ground was covered with pine needles. The butterworts were of a very pale yellow-green color. Some appeared almost without pigment. A number of plants had very long, thin leaves, and others had more moderately shaped leaves. I guessed that they were *P. lutea*, the "Florida Giant" variety, but there might have been some *P. pumila* among the smaller plants. I was hoping to see *P. primuliflora* and wondered if some of the larger plants might indeed be they.

Growing in the very same kind of habitat slightly further west near Fort Walton Beach, I found *P. planifolia*. This was surprising since I had been looking in whatever wet areas I could find for this plant and had found none. The *P. planifolia* was noticeably different from the first colony of butterworts; they were duller in appearance because of slight reddish pigmentation, especially along the curled edges. Also, the leaves were flatter and wider with only slight in-curling of the edges. The plants were set in the same fairly dry sandy soil — salt and pepper where exposed — with dried grey grass, pine needles, some green clubmoss and short green grasses as ground cover. I was very excited and the plants were quite beautiful — like jewels set in the

ground. Along with the *P. planifolia* grew *D. capillaris* and *D. intermedia,* with deep maroon-red coloration in the latter. It is interesting that the *P. planifolia* was growing in so dry a habitat, since it usually grows in a very wet habitat.

I drove on into Pensacola, Florida, and US Rt. 90, which would allow me to stop off the highway much more easily than Interstate 10. Looking from car window, I spotted long light green grass-like plants and thought, *"filiformis* var. *Tracyii!"* Indeed, growing in extremely dry white sand, they stood about a foot and a half and almost two feet tall in some cases. Many juvenile plants grew smaller. I was surprised at how thick the petioles and filiform leaves were. Previously, I had only seen the smaller, red tentacle species in the N.J. Pine Barrens which grows to about a foot tall.

At the next stop in the Florida panhandle I saw, at first, some very sad-looking *S. psittacina.* They were drying up and were camouflaged by surrounding dried grasses. The flower stalks helped me find individual plants. A short walk brought me healthier plants which photographed well. While checking the dried seed pods I discovered that many were inhabited by an insect larvae, probably a moth, which I have heard loves to live out a portion of its life within *Sarracenia* seed pods. It was distressing because about 8 out of every 10 seed pods were infested, and it seems to destroy the seed. I wondered about the effects this would have on future populations of *Sarracenia.*

I stopped one last time in Florida and discovered *S. alata* growing along the roadside at the edge of a dry savannah. I walked in through the tall grasses and soon saw more *S. alata* and was rewarded, also, with the sight of *S. leucophylla,* a few plants of the smaller, red-veined variety. They are surely the most striking of the *Sarracenia.* Walking further, I saw a clump of *S. flava;* these were very large plants with mouths probably a good three inches in diameter, and red patches in the throat. This clump of two or three plants showed the dog-day conditions in their brown spotted leaves.

In another area of the same savannah there were also more *S. psittacina* and some *S. rubra,* the small variety. Many of these plants, too, had been invaded by the moth larvae and occasionally a moth would flutter out from under the umbrella-like flower parts as I investigated.

Driving into Alabama I began noticing vast stands of *S. alata* so that, from my car, the savannahs and fields were streaked red with them. It was quite impressive. On examining the many plants of *S. alata,* I saw that some were green with red veins, others with deep red inside the mouth and on the underside of the ala, and older leaves were red and orange all over. The plants grew a short distance from the road and continued into the pine forest, on the northern side as far as I could see. The fields on the other side of the highway were also filled with *alata* and more were noticeable since the pine forest edge was about 150 yards in from the road. One last exciting find was an obvious hybrid between *S. alata* and *S. psittacina.*

(Received December 23, 1977)

SPECIAL ANNOUNCEMENT

Lynn H. Macey has moved (New address is 1377 Oakmont #10; McPherson, KS 67460). The plant exchange is back in operation. Lists are prepared quarterly with the main list out in February. No charge for listing, but the list will cost $1.00 USA, Can., Mex., $2.00 rest. Updates are out in May, August and September with new info only and will cost $.50 domestic, $1.00 rest each and can be ordered all or in part. See Issue #1 for other materials that Lynn offers through the Carnivorous Plant Information Service keeping the change in address in mind.

BOTANIST'S CORNER

by Larry Mellichamp

Botanical History of CP
I: *Sarraceniaceae*

Introduction

The group of plants known as Carnivorous, or Insectivorous, Plants is large and varied; its members are spread widely throughout the plant kingdom and over the globe (see CPN Vol. 7, No. 1, pp. 18-19).

The CP show a great deal of diversity in all features: flowers, roots, stems, and especially leaves. The only thing they all have in common is their ability to catch, digest, and absorb various form of animal prey via variously and highly modified leaves. It is not surprising that th char-acteristic was overlooked for many years as the various CP were discovered in the remote and not so remote corners of the earth. In many cases, the trapping mechanism is small and obscure, as in the widespread *Utricularia.* In other cases, the ability to catch insects is very obvious and was early recognized as a unique adaptation, as in *Dionaea,* a plant with a very restricted range as plants go. On the other hand, the pitcher plants, *Sarracenia,* which have been recognized botanically for over 275 years, were not proven to be truly carnivorous until the late 1880's when Dr. Joseph H. Mellichamp, a physician near Charleston, S.C., made the pioneer experiments that showed that insects were actually digested inside the pitchers. Before this time, many people thought the "water" was held in the leaves to be used by the plant in droughts; and that insects were in there "hiding" from predators.

It is interesting that while Charles Darwin, in his classic book Insectivorous Plants, meticulously studied specimens of *Dionaea, Drosera, Pinguicula, Utricularia* (all native to Europe except *Dionaea*), he did not observe *Sarracenia,* which surely were cultivated in England and accessible to him. Was it because it was not known that *Sarracenia* were carnivorous at that time?

Carnivorous plants have only relatively recently attracted attention horticulturally. For example, *Nepenthes* were first discovered in 1685; they were introduced live into England in 1750; but the first success at cultivating and artificial hybridizating did not occur until around 1850. It took that long to learn about the plant's habits and ecological requirements, and then to perfect the cultural conditions for growing them successfully.

In the next series of articles, I propose to discuss the various genera of CP from the historical point of view: their discovery, naming, attempts at cultivation, and especially the famous personalities associated with the CP over the years. CP provide a fascinating array of stories of exploration and discovery, confusion and controversy, fact and fiction, and detective work and legal action which rival adventure stories in excitement. Historical information on CP is often obscure and scattered. I have consulted such standard works as F. E. Lloyd (1945) *Carnivorous Plants,* L. H. Bailey (1917) *Standard Cyclopedia of Horticulture* and D. E. Schnell (1976) *CP of U.S. and Canada* in addition to older reference materials by original authors. It is interesting, though time consuming, to spend hours in large libraries tracking down odd books and journals to find little bits and pieces of information to make a larger story or answer a specific question. Some-

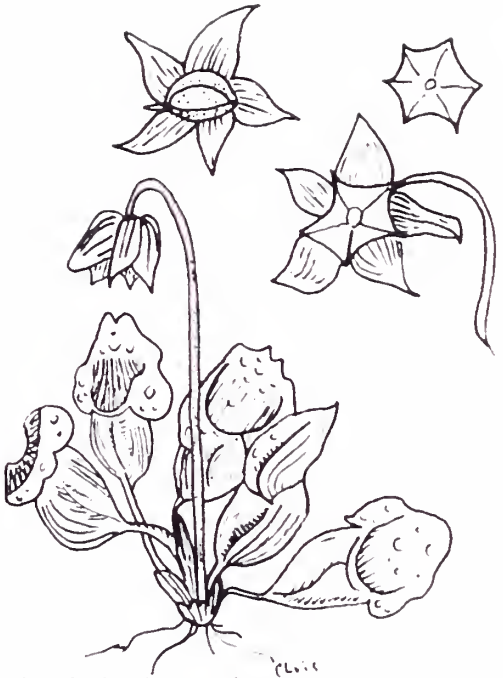
times it is frustrating to find what you are looking for, only to discover that it is in Italian (or some other unfamiliar foreign language). But the rewards are great!

Sarraceniaceae

The pitcher plant family *Sarraceniaceae* includes about 17 species in 3 genera and is completely confined to the New World (North America and N. E. South America). It is a distinctive and relatively uniform group morphologically and ecologically. The members are rather well known botanically and horticulturally and while some controversy does exist, there is a minimum of taxonomic and nomenclatural confusion.

The genus *Sarracenia* was one of the first CP to be discovered. According to Lloyd (1945 *loc. cit.*) the first known illustration (no specimen) was of a leaf of *S. minor,* probably from a Spanish explorer from Florida. The next appearance in Europe was in the form of a drawing of unknown origin of *S. purpurea,* in 1601. While it was not recognized as being carnivorous, the drawing was reproduced in the 1631 edition of Gerard's *Herbal* (a very large book on medical, herbal and horticultural botany of its day) in the hope that someone would rediscover the plant. It was discovered living by John Tradescant, a famous plant collector, in Virginia in 1640. He sent living specimens to England. In 1672 Josselyn in his book "New England Rarities" shows a drawing of what he calls the "Hollow Leaved Lavender," the plant which we now know as *S. purpurea,* (Fig. 1).

It was not given a generic name until 1700 when the famous French botanist Tournefort named it in honor of Dr. M. S. Sarrazin of Quebec, Canada, who sent Tournefort a specimen. This specimen was undoubtedly of the northern form *S. purpurea* ssp. *purpurea,* as opposed to the southern *S. purpurea* ssp. *venosa.* The name *Sarracenia* gained official status in



Josselyn's picture of the "Hollow Leaved Lavender," 1672. Redrawn from Bailey's *Cyclopedia* by Chris Sowers, UNCC.

1753 when Carl Linnaeus (the father of modern botany) used it in his book *Species Plantarum* ("Species of Plants"), which was the beginning of our modern naming system. Thus, the type, or first named form, for the genus was the northern form, probably the most typical of all the *Sarracenia* species because it is the only one that (1) grows naturally in the north; and (2) holds rain water in the open pitcher. It is *not* considered to be the most primitive, or first evolved, type of *Sarracenia.* While more research is needed, it is also possibly the only species that does *not* actually produce its own digestive juices, relying solely on bacterial decomposition in the pitcher fluid before absorbing nutrients.

Sarracenia flava is another important species in the South. It has long been known because it is large and conspicuous, and at one time was very abundant. Now, its habitat is severely threatened

(as are those of most *Sarracenia* species) in most areas of the S.E. coastal region where it grows. The story is told that in earlier days (perhaps even now) country folks would keep several potted specimens on the back porch before the advent of screening. They say the plants were relatively successful at attracting and catching flies and other insects, and thereby preventing them from entering the house; hence the common name "flycatcher," or "flytrap."

Sarracenia have long been a favorite horticulturally, especially the hybrids which seem to flourish. It is common knowledge that all species are capable of hybridizing in cultivation, and some magnificent selected forms have resulted. While many of the hybrids are more unusual than beautiful, a few are outstanding. Just as an example, *S.* X *catesbaei* (pronounced kates bee eye) is one of the most beautiful and vigorous, as well as being one of the first known (it was first discovered in 1717). It is a natural hybrid between *S. purpurea venosa* and *S. flava*. As with most plants, there is some confusion when it comes to naming hybrids. You can either give it a separate Latin name (e.g. *S. catesbaei*) or use the parents names as above. The "times sign — X" indicates hybrid. One of the most recent artificial hybrids is *S. minor* X *S. alabamensis* ssp. *wherryi* produced by Fred Case of Saginaw, Michigan (see next issue's cover of CPN). This hybrid does not have a separate Latin name yet, but it is quite charming. When making artificial hybrids, it is desirable to take care to select unusually good specimens to cross, to get the best possible hybrids with desirable characteristics of form and color.

Finally, one name that will always be associated with *Sarracenia* is that of Dr. Edgar T. Wherry (see CPN Vol. II No. 3). He is one of North America's most eminent botanists of this century. An excellent field botanist (and not just limited to *Sarracenia*!) his astute observations led to the formal recognition of northern and southern forms of *S. purpurea;* and to the realization that distinctive forms exist in the *S. rubra* complex (there is an ongoing controversy as to whether the forms are species, subspecies, varieties, or unworthy of recognition). He was the first to map the distributions of *Sarracenia* species; and the first to indicate that soil pH might be significant in explaining why certain plants are restricted to certain types of soils. Dr. Wherry is still alive (he is 93 years old) and lives in Philadelphia where he continues to curate a herbarium (dried plant specimens) and correspond on the subject of botany.

The species of *Sarracenia* and the meanings of their names:*

S. alata [Common name: Pale Pitcherplant] (alata = wing or flange, referring to wider rim of pitcher opening)

S. alabamensis [Alabama Canebrake pitcherplant] (alabamensis = coming from Alabama)

S. flava [Yellow Pitcherplant] (flava = yellow; referring to flowers &/or leaves)

S. jonesii [Upland Red Pitcherplant] (jonesii = named in honor of Dr. F. M. Jones, an authority on pitcher plant insects)

S. leucophylla [White-topped Pitcherplant] (leucophylla = white-leaved)

S. minor [Hooded Pitcherplant] (minor = smaller, or lesser, perhaps referring to the stature of the plant)

S. oreophila [Green Pitcherplant] (oreophila = mountain-loving; the plant comes from the uplands of NE Alabama)

S. psittacina [Parrot Pitcherplant] (psittacina = parrot-like. i.e. with green or contrasting colors)

S. purpurea [Purple Pitcherplant] (purpurea = purple color; flower &/or leaves)

S. rubra [Red Pitcherplant] (rubra =

red color; referring to the flower &/or leaves)

*Refer to early issues of CPN for details of ecology and culture.

Next — *Darlingtonia* and *Heliamphora*, a study in confused names.

Special Notice

We wish to apologize for omitting mention of The Plant Shop's Botanical Gardens as a CP source in the last issue. Write for their catalog (18007 Topham St., Reseda, CA 91335).

Q & A

What is a good method for propagating *Cephalotus follicularis?* MM, Merrimack, NH.

Cephalotus is easily propagated by division of the rhizome as well as by leaf cuttings. Hormone can be used to speed and improve rooting. Keep moist in well lit location between 70°-80°F. Do not keep too wet or cuttings will rot. Sphagnum is best for rooting, but you probably could use medium size vermiculite. (LCS)

Beginner's Corner

by L. Song

(Continued from last issue)

Asexual methods, on the other hand, require only a "starter plant" or a portion thereof. Large numbers of uniform individuals can be built up relatively quickly and has proven to be the difference between making a plant very rare or common. A good case in point are the pygmy droseras. Seeds of these species have generally been very difficult to germinate, but they make up for this in producing specialized bodies called gemmae that are ready-made buds with a built-in food supply that begin to grow almost immediately after being shed from the mother plant. These propagules can even be induced under controlled conditions — short photoperiod (fewer than 12 daylight hours in a given 24 hour period) and relatively low temperatures. More on these methods when propagation of these species are discussed further.

Propagation by asexual means must also be used where a particular variety or hybrid is to be increased. To use seed of these would result in progeny with mixed genetic makeup, different from the special variety or hybrid and therefore undesirable. Furthermore, in cases where portions, such as a leaf, stem or root, are used, these can be taken almost at any time the plant is in active growth, which is generally a longer period per given season than when seed is available.

In propagating a given plant, a balance must be reached between the two methods and the ultimate goal must also be considered. Sexual propagation will ensure the variability of the offspring and would make them, through time, better able to adapt to changes in their environment, whereas the production and distribution of asexually propagated plants results in a more uniform group and therefore a more highly vulnerable population to changing conditions. The latter method works in cultivation because we can control the environment more.

Now we will begin a discussion of each of the genera and the methods of propagation generally employed starting with the genus *Sarracenia.*

SARRACENIA PROPAGATION

by DE Schnell

Sarracenia propagation is accomplished by sexual and asexual (vegetative) means, although the latter is practically limited to rhizome division of various sorts. Since Sarracenias can be brought to flowering size in three to five years from seed, and seeds and seedlings are relatively easy to handle, this method is emphasized.

1) Sexual propagation

a) Pollination — This has been discussed with an illustration in a previous issue of CPN (CPN 2:40, 1973), but will be briefly reviewed here. Pollen of all species and hybrids of *Sarracenia* has been shown to be 95-100% fertile and there are no genetic barriers. Thus one can effectively self-pollinate any species or hybrid, and cross any pair of species or hybrids, with resulting fertile seed and healthy progeny. Pollination is best accomplished five days into anthesis. If the plants are outdoors and one wishes to control his results, the flowers must be covered as they open and until shedding of petals by a loose sack of cheesecloth or gauze snugged (not strangulated) around the scape to prevent insect pollination. Pollen is shed into the cup of the umbrella-like expansion of the style and a good quantity is available. At each of the five tips of the umbrella, at the base of a small v-shaped cleft at the tip, is a tiny projection or stigma lobe upon which the pollen must be placed. This is best accomplished by using the flat end of a toothpick which can then be disposed of after each use. The classical pollinator's brush retains too much pollen, is difficult to clean and too expensive to be thrown away. You want to try to prevent mixing of pollens in order to obtain meaningful results. Apply a small scoop of pollen to the stigma lobes of the same or another plant (same or other species or hybrid) by lightly touching the stigma with the pollen. Theoretically, due to the anatomical structure of the stalk-like portion of the style that is connecting the umbrella to the swollen ovary, only one stigma lobe need be pollinated, but I usually do at least two or three to be certain. If you are trying to cross and not self-pollinate plants, be careful not to drop pollen on the stigma lobe of the flower from which you are removing the pollen. After pollination, carefully tag your flowers with any suitable coding system so you will have a record of what was done and which resulting seedpod is what. By the way, pollen can be stored *dry* in a wax paper wrap in the refrigerator for at least six weeks to accommodate experiments among species with differing flowering dates.

b) Seed — During the summer, the swollen ovary at the base of the flower will gradually ripen into a seedpod if pollination was accomplished properly. In the autumn, fully mature seed is indicated by the pod turning brown and somewhat hard, and/or splitting of the pod which may still appear yellow-green but is dry. Clip the pod from the scape and collect your seed over a sheet of paper in a still place by manually separating the partitions of the pod and letting the seed fall on the paper. Good seed will be plump, dry and colored from tan to a dusty lavender. Be careful not to mix seed from different experiments. If necessary, allow the seed to dry on the paper for a few hours, then store in a refrigerator in either polyethylene bags, wax paper wraps, or small screw-cap vials to keep the seed dry. Refrigerator storage, in my experience, can be as long as five years with little loss of viability, viability tending to slowly decrease after that. Seeds store much more poorly at room or warm temperatures. I do not recommend freezing.

c) Sowing — *Sarracenia* seed will germinate more promptly and vigorously if subjected to a process called stratification by horticulturalists. Stratification is less important with so-called southern

Sarracenia rubra.

Note the deposits of enticing nectar on the edge of the mouth of the pitcher and the downward pointing hairs.

Photo by Steven A. Frowine. The Garden Center of Greater Cleveland.

species, but still the process results in the quickest burst of germination and the greatest number of robust seedlings. Stratification simply mimics the cold, damp conditions to which autumn-shed seeds are exposed during winters in habitat. This is accomplished by sowing your seed (not too thickly) in pots of either chopped live green sphagnum, chopped wetted "long fiber" sphagnum purchased in gardening stores, or even wetted German or Canadian (*not* Michigan) peat. I have more fungus problems with the peats. Label the pots, then cover by placing in plastic bags or a moisture-tight plastic container, and place in the ordinary household refrigerator (*not* the freezer) for at least six weeks. A minimum of four weeks is required for some species, and it does no harm to prolong to 8-10 weeks. At the end of stratification, remove the pots from the plastic bags and place them in terraria under lights or in the greenhouse. Bottom heat helps germination in cool weather. You should see activity in 7-10 days with complete germination in 14-16 days. Transplant after the first two true leaves appear.

d) Problems with seed — Sometimes you will come up with an empty seedpod, in which case pollination was not accomplished. Review your technique. Sometimes various insect larvae will feed on developing seedpods; inspect your plants regularly. Failure of germination is usually due to seed that is too old or improperly stored, lack of suitable germination temperature (use bottom heat of 72-74°F in cool weather), inviable seed (these are shriveled, dark brown and have an angular, small appearance) or lack of stratification. I have never had damping off of seedlings using sphagnum and proper light (full sunlight in greenhouse, fluorescent lights no more than six inches above pot surfaces in covered terraria).

(To be continued)

N & V

(Continued from Page 38)

have opened. This seems to be a definitive characteristic of the two species — at least for my plants. I wonder if this habit has been described before?

J. A. Mazrimas has sent the order for the Japanese books. Order should arrive in about 90 days.

Drosera regia
Photo by Joe Mazrimas

WANT ADS

Walter Greenwood, 1838 Menold Court, Allison Park, PA 15101. (TS) Nepenthes khasiana, Sarracenia flava, S. rubra, S. minor, S. purpurea, S. oreophila (seedlings), S. leucophylla x purpurea (x mitchelliana) (seedlings), Utricularia dusenii, U. longifolia, Drosera binata, D. filiformis tracyi, D. spathulata kansai (seedlings), D. x nagamoto. (WTB) Aldrovanda, Heliamphora ssp., Nepenthes ampullaria, N. lowii, N. bicalcarata, N. edwardsiana, N. fusca, N. stenophylla, N. tentaculata, N. villosa, Australian CP.

Scott Henderson, 215 N. Cuyamaca Street, El Cajon, CA 92020. (WB) Heliamphora, tuberous Drosera. Sarracenia hybrids. (W) S. psittacina, S. alata, any of the Central American Pinguicula, Nepenthes (any except khasiana and macfarlanei). (T) D. brevifolia (white flower), D. indica, P. caerulea, U. prehensilis. U. longifolia, D. californica, D. hybrids, D. burkeana, B. liniflora, and more.

Stephen Jackson, 478 Mitcham Road, Mitcham, Victoria, Australia 3132. (T) Nepenthes khasiana seed, Drosera pygmaea seed, Drosera whittakerii seed for (TB) Cephalotus seed, Byblis gigantea seed, Drosera filiformis seed, Nepenthes rafflesiana seed, Drosera schizandra seed.

Terry Leir, P.O. Box 918, Libby, Montana 59923. (WTB) Heliamphora sp.

Mark Maloof, Bel Air Park #6B, Merrimack, NH 03054. (WB) Any Nepenthes or Cephalotus plants or cuttings.

Randy Raymong, 7415 Richie Road, Stittville, NY 13469. (B) Cephalotus follicularis, Dionaea over 15 years old, N. alata, Heliamphora, N. rafflesiana.

Bill Scholl, 11420 Winterpock Road, Chesterfield, VA 23832. (WB) Drosera regia, D. gigantea, Nepenthes lowii. N. villosa, N. ampullaria, Heliamphora.

Ernest Taniguchi, 45-1040D Wailele Road, Haneohe, HI 96744. (WB) Seed or plants of Sarracenia psittacina, S. purpurea f. heterophylla, Pinguicula sp. Drosera sp. (easy to grow type); Heliamphora sp., Aldrovanda vesiculosa, "Insectivorous Plants (Photo Illust.)" by Shimizu, "The Wonder of Insectivorous Plants" by Kasahara.

Parker Webb, 302 Stayman Dr., Ranson, WV 25438. (W) Indoor greenhouse, information on culture of Heliamphora ssp., people in Charlestown, WV, area interested in forming a Carnivorous Plant club. (WB) Heliamphora ssp. (plants, seeds or cuttings), any aquatic bladderwort, Cephalotus.

Photo by Tommy Enomoto

Born and raised in Southern California, Leo C. Song, Jr., one of your newest co-editors, has had a lifelong interest in plants. While in high school, he bought a *Dionaea* and planted it in the "best garden soil available" in a gallon jar. It lasted about two months. So ended his first experience with CP.

One day, about 15 years ago while a student at UCLA, he happened to see a catalog of the now defunct Oakhurst Gardens owned by Jimmy Giridlian. Several CP were offered at reasonable prices. Upon receiving the order of plants, he noticed that they were planted in sphagnum moss. This seemed to be the secret to growing the heretofore "impossible to grow out of their native habitat" CP. Once that problem had been taken care of, other plants obtained did very well. Descendents of the *D. capensis* and *D. binata* — simple form as well as several clones of *S. alata* and *S. leucophylla* survive to this day.

In 1971, he got the job of greenhouse technician at California State University, Fullerton. There were no CP to be seen, so plants were brought from home. He had heard of CPN coming out, so a letter was sent to a Mr. J. A. Mazrimas, along with a dollar for the first year's subscription. The arrival of the first three issues really opened his eyes to the world of CP. Blessed with four large greenhouses and a large lath house plus generous donations of seed and plants, the CP collection at Cal State has increased to the point where it offers one of the best opportunities for professionals and laymen alike to view and study most of the major genera of CP.

This opportunity will be greatly enhanced by the completion of an artificial bog in the Arboretum now under construction at Cal State. This bog will feature mass plantings of any CP that will survive outside in S. California. (*Dionaea, Sarracenia,* many Droseras, some Utricularias, etc. do very well outside.) Plantings of bog orchids and other small bog plants is also planned pending completion and acquisition of the plant materials.

All of these activities plus research with *Sarracenia* and *Nepenthes* hybrids promise to keep him busy for some time to come.

Pinguicula colimensis is illustrated here in this *painting* by R. Scott Bennett. Note the particularly long spur and the nectar "guidelines." This species is a native of the mountains of Mexico. Photo of painting by J. A. Mazrimas.